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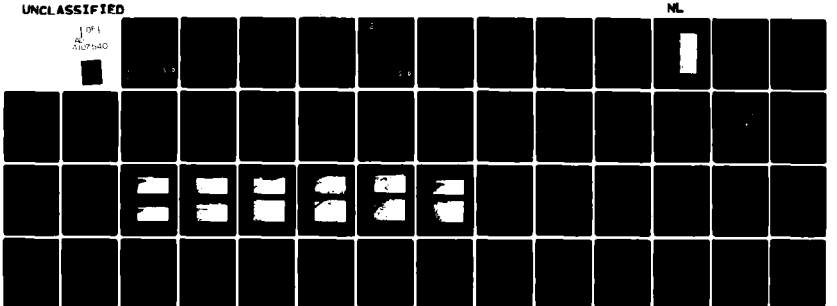

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MISSOURI-NEMAHA-NODAWAY BASIN

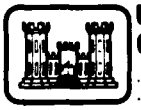
LEVEL II

MONONAME 27 DAM

HOLT COUNTY, MISSOURI

MO. 10353

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



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St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

MAY, 1979

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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☆ U.S. G.P.O. 1980-665-141/1299

MONONAME 27 DAM

HOLT COUNTY, MISSOURI

MISSOURI INVENTORY NO. 10353

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY
HOSKINS-WESTERN-SONDEREGGER, INC.
CONSULTING ENGINEERS
LINCOLN, NEBRASKA

UNDER DIRECTION OF

ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

MAY, 1979

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Mononame 27 Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Mononame 27 Dam:

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass 50 percent of the Probable Maximum Flood.
2) Overtopping could result in dam failure.
3) Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED
Chief, Engineering Division — 20 SEP 1979 — Date

APPROVED: SIGNED
Colonel, CE, District Engineer — 20 SEP 1979 — Date

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

Name of Dam	Mononame 27 Dam
State Located	Missouri
County Located	Holt County
Stream	Davis Creek Offstream
Date of Inspection	May 16, 1979

Mononame 27 Dam was inspected by an interdisciplinary team of engineers from Hoskins-Western-Sonderegger, Inc. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. Failure would threaten life and property. One dwelling with associated farm buildings and one county road lie within the estimated damage zone which extends approximately one half mile downstream of the dam.

Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the recommended guidelines for a small dam having a high hazard potential. Considering the volume of water impounded, the large floodplain downstream, the one house with associated farm buildings, and the road system downstream of the dam, one-half of the Probable Maximum Flood is the appropriate spillway design flood. The spillway will pass the 100 year flood (flood having a one percent chance of being exceeded in any year) without overtopping the dam. The spillway will pass 30% of the Probable Maximum Flood without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

No design data were available for this dam. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These analyses should be obtained in the future.

Other deficiencies observed during the inspection are a heavy growth of willow trees on the upstream slope, erosion of the upstream face, and rodent holes in the downstream face.

Several items of preventative maintenance need to be initiated by the owner. These are described in detail in the body of the report.

Rey S. Decker
E-3703

Gordon Jamison

Garold Ulmer
E-4777

H. P. Hoskins
Harold P. Hoskins
Chairman of Board
Hoskins-Western-Sonderegger, Inc.
E-8696

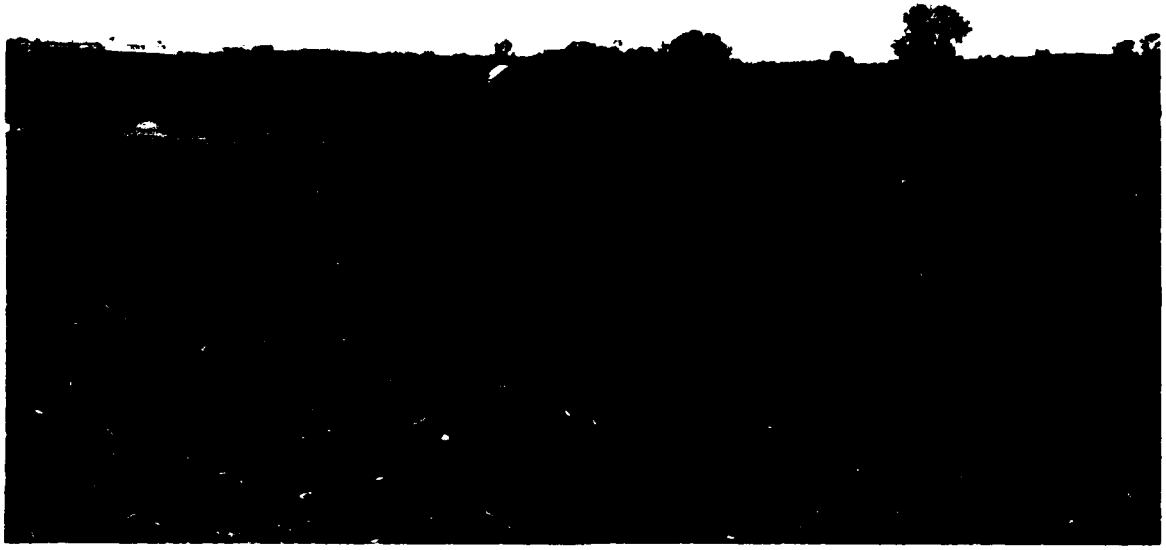


PHOTO NO. 1
OVERVIEW TAKEN FROM
NORTH ON LEFT SIDE

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
MONONAME 27 DAM - MO 10353
HOLT COUNTY, MISSOURI

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Mononame 27 Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams". Appendix D to "Report of the Chief of Engineers on the National Program of Inspection of Dams", dated May, 1975, and published by the Department of the Army, Office of the Chief of Engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances. Mononame 27 Dam is an earthfill structure approximately 600 feet in length with a maximum height of approximately 19 feet. The vegetated earth spillway is cut into the left (east) abutment. The exit channel for the spillway discharges along the downstream toe of the dam from the left abutment to the old creek channel.

b. Location. The dam is located in the northeast part of Holt County, Missouri, as shown on Plate A-2. The dam is shown on Plate A-1 in the SE¼ of Section 16, T62N, R38W. The lake formed behind the dam is shown in the SE¼ of Section 16, T62N, R38W.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, this dam and impoundment is in the small size category.

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph 1.1c above. Based on referenced guidelines, this dam is in the High Hazard Classification. The estimated damage zone extends approximately one-half mile downstream of the dam. Within the damage zone are one dwelling with associated farm buildings and one county road.

e. Ownership. The dam is owned by Ronnie Tenney, Mound City, Missouri 64470.

f. Purpose of Dam. Erosion and flood control.

g. Design and Construction History. According to the inventory data, the dam was constructed in or about 1962. The owner of the property when it was constructed was not available and no information was available on the design or construction of this dam.

h. Normal Operational Procedure. The spillway is uncontrolled and the pool level is maintained at or near the spillway crest elevation. Ronnie Tenney, the present owner, reported that he thought the spillway operated in 1974.

1.3 PERTINENT DATA

a. Drainage Area. 0.146 sq. mi. (93.4 acres)

b. Discharge at Damsite.

(1) All discharge at the damsite is through an uncontrolled earthen spillway.

(2) Estimated maximum flood at damsite - unknown.

(3) The emergency spillway capacity varies from 0 c.f.s. at elevation 980.7 (low point in spillway) to 50 c.f.s. at elevation 982.2 (low point on dam crest and maximum pool level).

c. Elevation (feet above MSL).

(1) Top of Dam - 983 ± (nominal), 982.2 (low point)
(2) Normal Pool - 980.7 ±
(3) Spillway Crest - 980.7 ±
(4) Stream bed at ℄ of dam - 964 ±
(5) Maximum tailwater - unknown.

d. Reservoir. Length of maximum pool - 800 ft. ±

e. Storage. (Acre-feet)

(1) Spillway Crest (low point) - 140 ±
(2) Top of Dam (low point) - 170 ±

f. Reservoir Surface (acres).

(1) Top of Dam (low point) - 7+
(2) Spillway Crest (low point) - 6.5+

g. Dam.

(1) Type - earthfill
(2) Length - 600 ± feet
(3) Height - 19 feet ±
(4) Top Width - 15 feet
(5) Side Slopes

(a) Downstream - 1 V on 2.2H (overall-measured)
(b) Upstream - exposed surface nearly vertical

(6) Zoning - unknown
(7) Impervious core - unknown
(8) Cutoff trench - unknown
(9) Grout curtain - unknown
(10) Drains - unknown
(11) Wave protection - none
(12) Downstream slope protection - vegetation

h. Diversion Channel and Regulating Tunnel - none.

i. Spillway.

(1) Type - uncontrolled, vegetated earth
(2) Location - left (east) abutment
(3) Crest elevation - 980.7 feet
(4) Control section - 15 feet ± wide, 48 feet ± long
(5) Downstream channel - no constructed channel.

j. Regulating Outlets - none.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available.

2.2 CONSTRUCTION

No construction records were available for this dam. It was reported that the dam was built in 1962.

2.3 OPERATION

No data were available on the operation of the spillway. It was reported by Ronnie Tenney, owner, that the spillway operated in 1974.

2.4 EVALUATION

a. Availability. No engineering data were available for evaluation.

b. Adequacy. The field surveys and visual observations presented herein are considered adequate to support the conclusions of this report. Seepage and stability analyses comparable to the requirements of the 'Recommended Guidelines for Safety Inspection of Dams' were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of Mononame 27 Dam and appurtenances was made on May 16, 1979. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska, making the inspection were: Gordon Jamison, Hydrology; Gerald Ulmer, Civil Engineer; and Rey S. Decker, Geology and Soil Engineering. Photographs taken during the inspection are shown in Appendix B. Specific observations are discussed below.

b. Dam. This dam is a low earthfill structure built about 1962. The dam is located in the loess hills adjacent to the Missouri River. The abutments consist of 5 to 10 feet of loess overlying fine grained, plastic glacial till. Glacial till is exposed on the left abutment hillside some 15 to 20 feet above the elevation of the reservoir level. The loess soils capping the till are classed as medium plasticity CL. The till is dense and highly plastic CL or CH material containing occassional fine to medium sized gravels. Soils in the valley section consist of medium to highly plastic CL alluvium derived from the loess and the glacial till. The depth of alluvial soils is not known.

Materials in the surface of the dam are moderately plastic CL soils.

The 15 foot wide crest of the dam is well vegetated but is somewhat rutted by vehicular travel. The profile along the crest of the dam is somewhat irregular varying in elevation from 982.2 to 983.7 $\pm$ as shown in Appendix C. No cracks nor abnormal longitudinal deformations were noted on the crest. No evidence exists of dam overtopping.

The upstream face of the dam is covered with many willow trees ranging in size up to 3 or 4 inches in diameter. Most of the upstream slope has eroded to a near vertical face from the upstream crest down to the water level, as shown in Appendix B, Photo No. 11. A relatively flat, berm-like shoulder has developed just below the reservoir level upstream from the vertically eroded face. This berm-like shoulder supports most of the willow growth.

The downstream slope is covered with an excellent

vegetative cover of brome grass, lespedeza and other adapted grasses. Several rather large, 4 to 6 inch diameter rodent holes were observed on the downstream slope. A stick was inserted into one hole, Appendix B, Photo #7, to a depth of about 4 feet on an angle of about 45^{0} from horizontal. No seepage outcrops were noted on the downstream face of the dam. However, seepage outcrops along the toe of the dam from approximate station 1 + 50 to 5 + 60. All seepage is clear and ponded with no evident discharge velocity. Seepage through the right abutment outcrops in the plowed field downstream from approximate centerline stations 5 + 00 to 5 + 60. This wet area extends 15 to 20 feet outside of the toe line of the dam.

There appears to be an old slip in the downstream slope located opposite about station 4 + 00. The slip occurred about 5 to 6 feet upslope from the toe, and is semi-circular in shape. It is about 20 feet wide, at the base and probably located over the old valley section. There is no seepage in the slip area and it appears to be stable. The cross section shown in Appendix C details the old slip area. No other cracking, settlement, or sinkholes were observed.

A one inch steel pipe, for stock water use, comes through the base of the dam at about station 2 + 50. The valve near the outlet end of the pipe is non-operable at the present time.

c. Appurtenant Structures. The uncontrolled spillway consists of a vegetated earth cut through the left abutment with the exit channel following the trace of the downstream slope of the dam. The crest or control section is 15 feet ± wide and approximately 48 feet long. The crest of the spillway is approximately 2.3 feet below the top of dam. At the time of inspection, the water level in the reservoir was about 0.5 feet below the crest of the spillway which is the highest level the present owner has noted since 1976. The spillway is well vegetated with no signs of erosion. It was reported that the spillway operated in 1974.

d. Reservoir Area. The reservoir area is bordered with a well vegetated buffer or siltation strip between the reservoir and adjacent cultivated land. No erosion was noted around the reservoir.

e. Downstream Channel. The Channel downstream from the dam consists of a broad, well vegetated waterway without a well defined channel.

3.2 EVALUATION

The tree growth and the erosion on the upstream face of the dam could result in potential for failure of this structure. Additional studies would be required to determine the structural stability of the downstream slope from the standpoint of shear strength and seepage pressures. However, at the time of inspection seepage pressures did not appear to be excessive and no recent deformations were noted in the downstream slope with the present high reservoir level which is only about three feet below the top of dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for this dam. The water level in the reservoir is controlled by precipitation, runoff, evapo-transpiration, seepage and the capacity of the uncontrolled spillway.

4.2 MAINTENANCE OF DAM

There is no regular maintenance program in effect for this structure. The owner reported that he plans to remove and treat the willow growth along the upstream face. The erosional damage of the upstream face should also be rectified.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

Upon checking with the owner there are no emergency plans or warning systems in effect for this dam.

4.5 EVALUATION

A serious potential of failure may result if the deficiencies in maintenance are not corrected.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No design data were found for this dam.

b. Experience Data. The drainage area, reservoir surface area, and elevation-storage data were developed from the USGS Maitland, Missouri 15 minute topographic quadrangle map. The hydraulic computations for the spillway and dam overtopping discharge ratings were based on data collected in the field at the time of the field inspection.

c. Visual Observations.

(1) There is no outlet pipe through the dam. The only discharge is through the uncontrolled vegetated earth spillway at the left (east) abutment.

(2) The spillway has an irregular trapozoidial shape with a well grassed channel bottom and side slopes. There is some evidence of scour at the extreme downstream end.

d. Overtopping Potential. The spillway is too small to pass 50% of the probable maximum flood without overtopping the dam. The spillway will pass 30% of the probable maximum flood without overtopping the dam. The spillway will pass the 100-year frequency flood without overtopping the dam. The effect of overtopping on the structural or erosional stability of this dam is expected to be minimal. The results of the routings through the reservoir are tabulated in regards to the following conditions:

Frequency	Inflow Discharge c.f.s.	Outflow Discharge c.f.s.	Maximum Pool Elevation	Freeboard Top of Dam Min. Elev. 982.2	Time Dam Overtopping Hr.
100 Yr.	430	10	981.5	+0.7	-
0.5 PMF	800	160	982.8	-0.6	6
PMF	1600	1040	983.7	-1.5	10
0.3 PMF	500	50	982.2	0	-

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineer, this dam is classified as having a high hazard rating and a small size. Therefore, the one-half PMF to the PMF is the test for the adequacy of the dam and its spillway.

The estimated damage zone is described in Paragraph 1.2d of this report.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation. The 2.2H on 1V downstream slope should provide adequate safety against major shear failures of this low dam. The small slide area observed on the downstream face probably resulted from over stressing a localized area of the valley alluvial foundation shortly after construction of the dam.

The seepage outcropping along and downstream from the toe of the dam undoubtedly comes through the foundation. The volume of seepage is low and exit velocities must be very slow since all effluent is clear. The seepage does not have any apparent adverse affect upon the present stability of the dam.

Erosion and sloughing of the upstream face could lead to potential failure of the structure. However, the vegetative cover and the nature of the materials in the dam indicate that the dam could probably withstand considerable overtopping flow without significant damage.

b. Design and Construction Data. There were no design or construction data available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Operating Records. There are no controlled operating facilities on this dam. Vegetation and materials in the spillway should withstand considerable flow without significant damage.

d. Post Construction Changes. No post construction changes on this structure are known to the inspection team.

e. Seismic Stability. The structure is located in the Zone 1 seismic probability area. An earthquake of the magnitude predicted in this zone is not expected to cause structural failure of this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. The ultimate safety of this dam is imperiled by the tree growth and erosion on the upstream face. Seepage along the downstream toe and structural stability do not at the present time appear to be critical to the safety of the dam. The spillway will pass the flood produced from 30% of the probable maximum flood. The effect of overtopping and/or spillway discharges on the structural or erosional stability of the dam are expected to be minimal.

b. Adequacy of Information. Due to the lack of engineering data, the conclusions in this report are based upon performance history and visual observations. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. A program should be developed as soon as possible to monitor at regular intervals the deficiencies described in this report. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. The items recommended in paragraph 7.2.a should be pursued on a high priority basis.

d. Necessity for Phase II. Phase II investigation is not considered necessary.

e. Seismic Stability. The dam is located in Seismic Zone 1. An earthquake of this predicted magnitude is not expected to be hazardous to this dam.

7.2 REMEDIAL MEASURES

a. Alternatives.

(1) The spillway on the left abutment should be enlarged. The enlarged spillway should have the capability of passing 50% of the probable maximum flood without overtopping the dam.

(2) The damage done by erosion on the upstream face should be repaired and measures taken to prevent erosion in the future.

(3) Seepage and stability analyses should be conducted.

b. O & M Procedures

(1) Willow trees and brush should be removed from the upstream embankment.

(2) Rodent holes should be repaired.

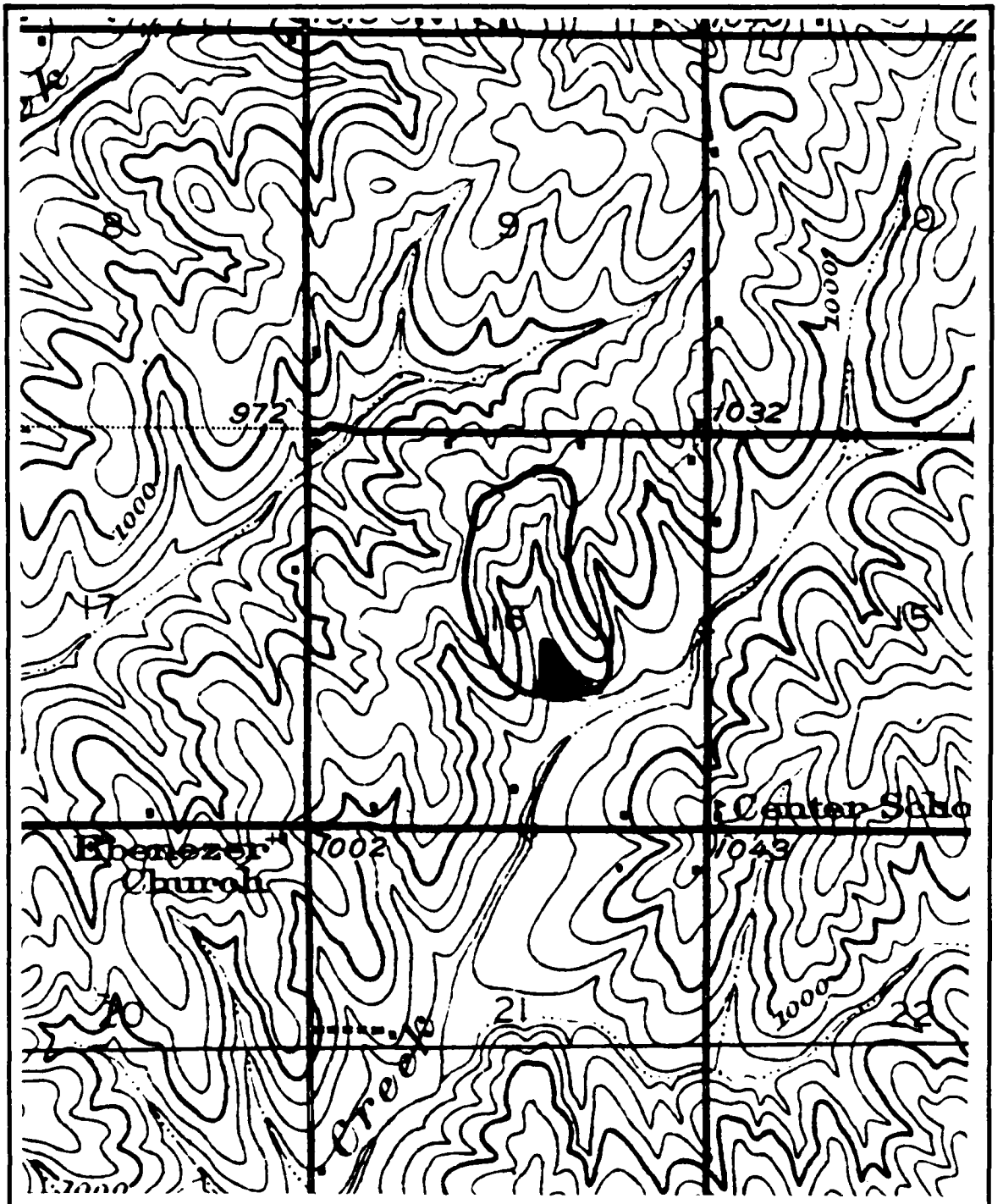
(3) Grass and weeds growing on the embankment should be mowed on a regular basis.

(4) The dam should be inspected on a periodic basis to monitor vegetative growth, erosion of embankment and rodent infestation. The inspections should be followed by a preventative maintenance program that will cause repair to be done on a timely basis in order to protect the integrity of the dam.

(5) A periodic check of the 1-inch pipe stockwater pipe as a possible source of seepage should be initiated.

(6) A professional engineer experienced in the design and construction of earth dams should be retained by the owner to perform the work stated in 7.2a and 7.2b.

APPENDIX A
MAPS



Scale in feet

2000 1000 0 2000 4000

N

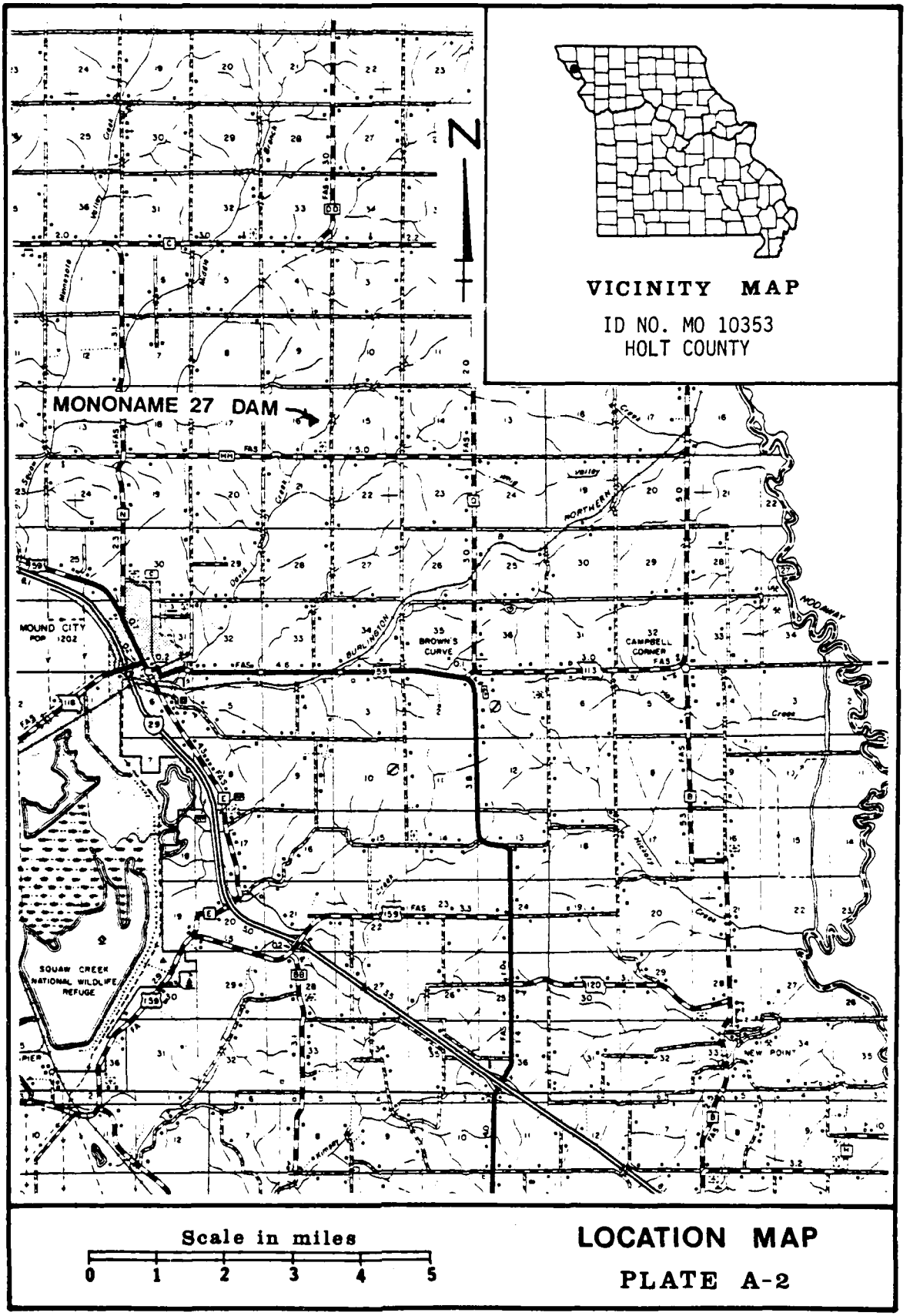
VICINITY TOPOGRAPHY

MONONAME 27 DAM

HOLT COUNTY, MISSOURI

MO. 10353

PLATE A-1



VICINITY MAP

ID NO. MO 10353
HOLT COUNTY

LOCATION MAP

PLATE A-2

APPENDIX B
PHOTOGRAPHS

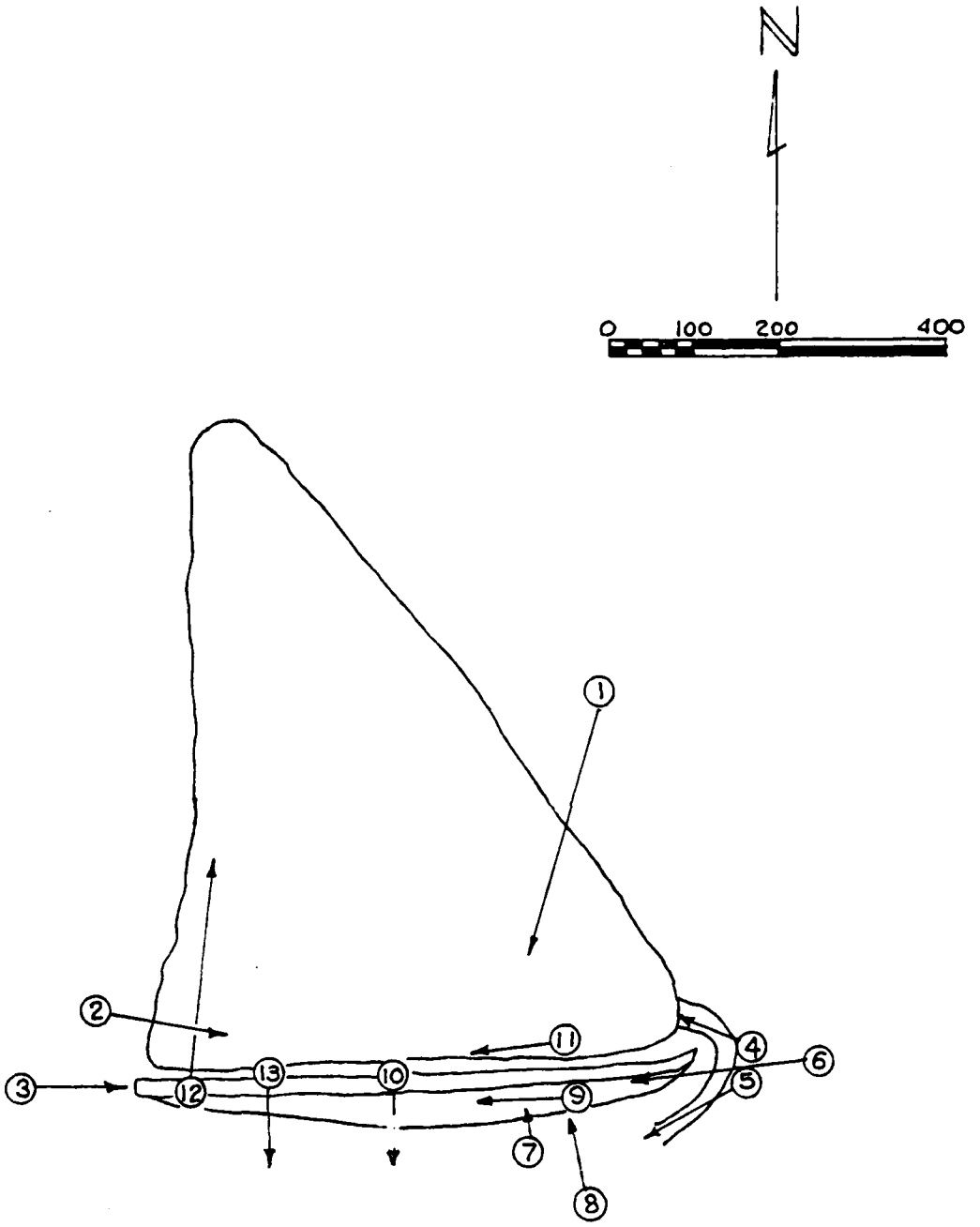


PHOTO INDEX

MONONAME 27 DAM

HOLT COUNTY, MISSOURI

MO. 10353

PLATE B-1

PHOTO NO. 2 - TAKEN FROM RIGHT SIDE SHOWING UPSTREAM FACE.

PHOTO NO. 3 - LOOKING ALONG CREST OF DAM FROM RIGHT SIDE.

PHOTO NO. 4 - LOOKING UPSTREAM ALONG EMERGENCY SPILLWAY.

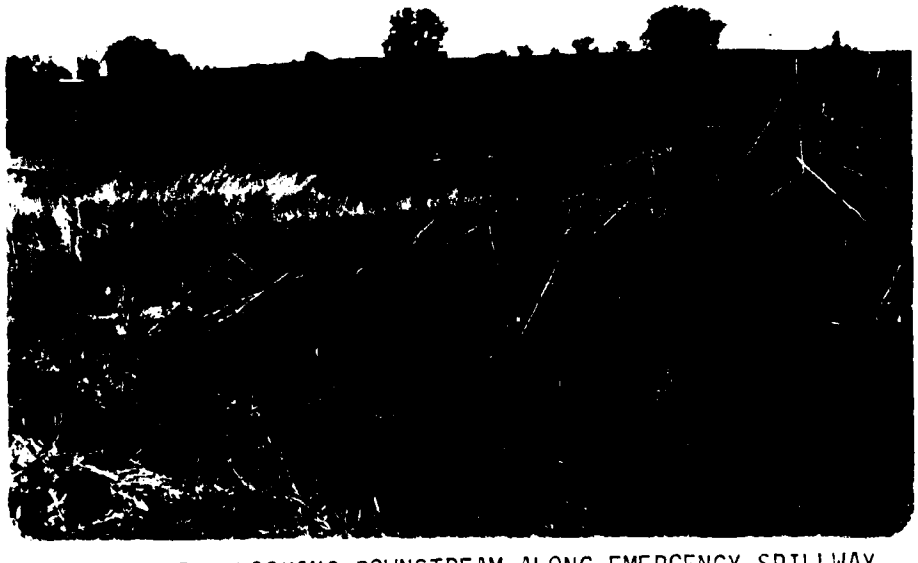


PHOTO NO. 5 - LOOKING DOWNSTREAM ALONG EMERGENCY SPILLWAY.

PHOTO NO. 6 - DOWNSTREAM SLOPE TAKEN FROM LEFT END.

PHOTO NO. 7 - LARGE RODENT HOLE IN DOWNSTREAM FACE OF DAM.

PHOTO NO. 8 - SEEP AREA DOWNSTREAM OF TOE BETWEEN STA. 1+50 AND STA. 3+00.

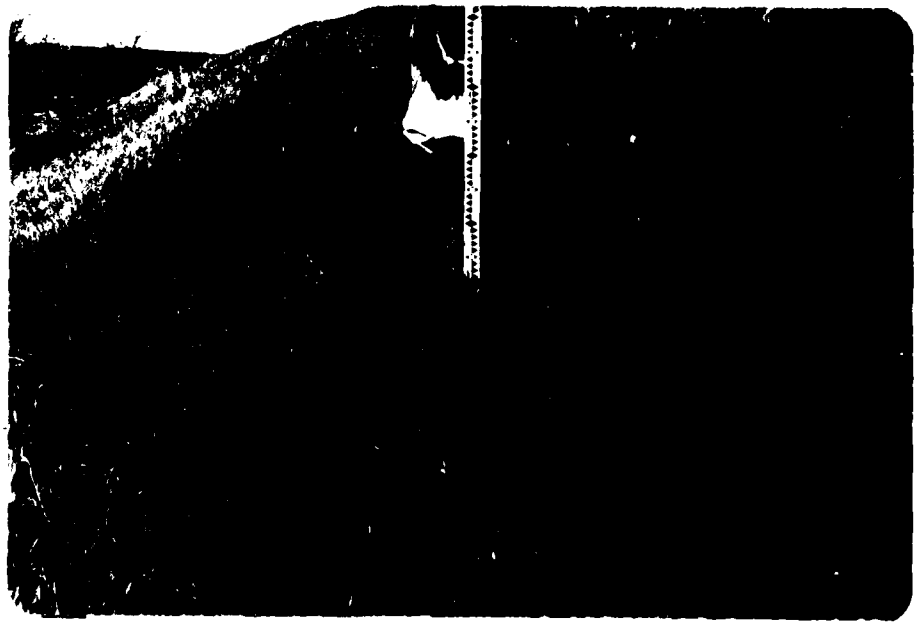


PHOTO NO. 9 - SLIP AREA AT STA. 4+00.

PHOTO NO. 10 - LOOKING DOWNSTREAM. SURVEY ROD AT SLIP AREA.

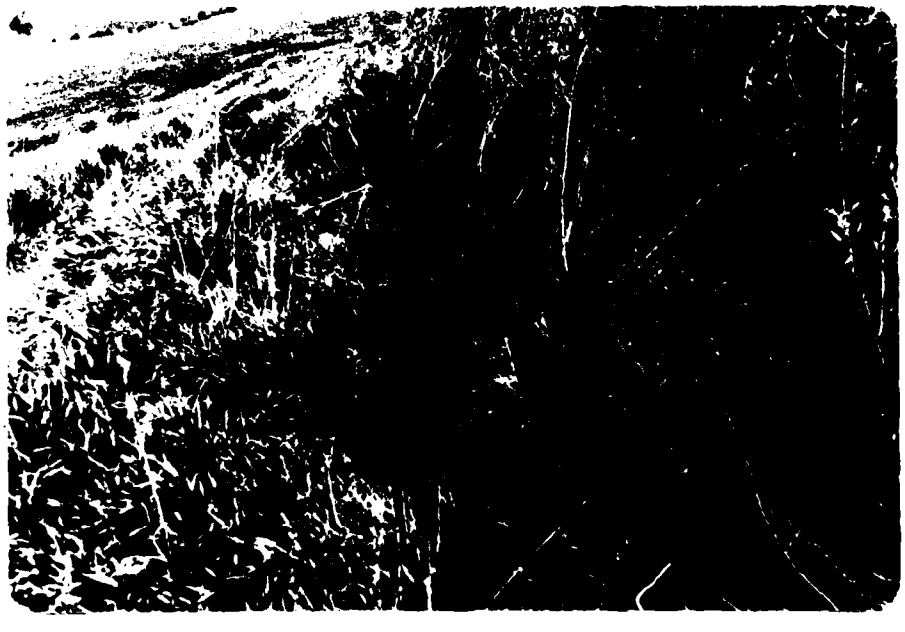
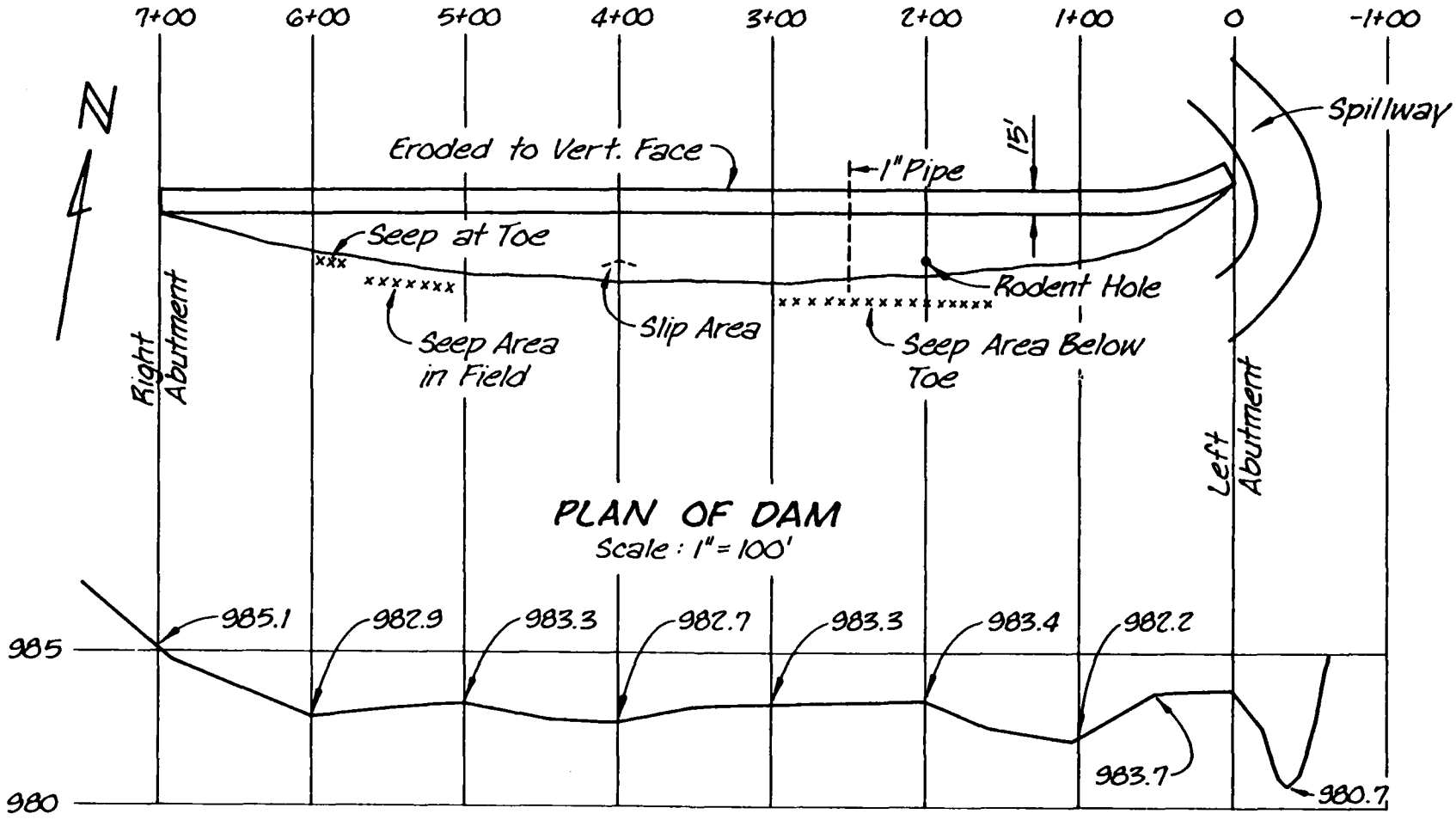


PHOTO NO. 11 - TAKEN FROM LEFT END SHOWING EROSION OF UPSTREAM FACE.

PHOTO NO. 12 - LOOKING UPSTREAM ACROSS RESERVOIR FROM STA. 6+00.

PHOTO NO. 13 - LOOKING DOWNSTREAM AT SEEP AREA IN FIELD BETWEEN STA. 5+00 AND STA. 5+60.

APPENDIX C
PROJECT PLATES



PLAN OF DAM

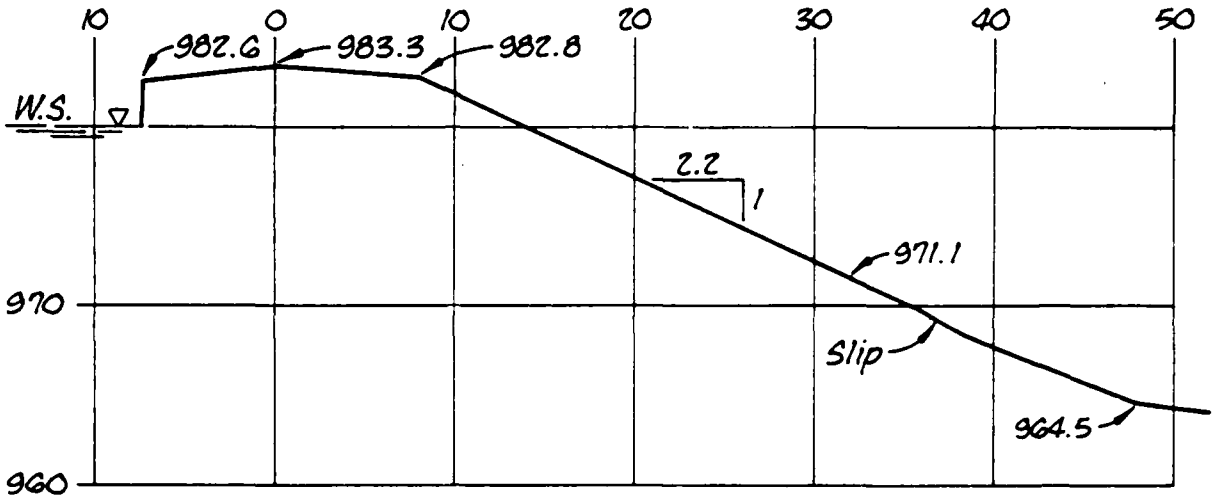
Scale : 1" = 100'

PROFILE ALONG CENTERLINE OF DAM

Scale : 1" = 100' H.

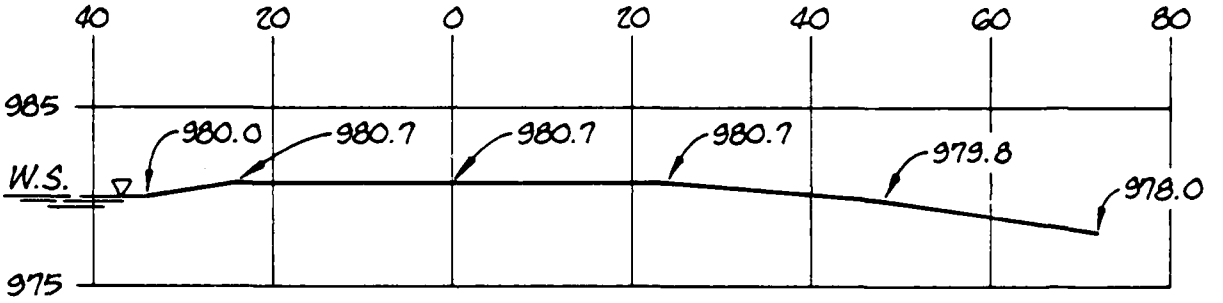
1" = 5' V.

PLATE C-1



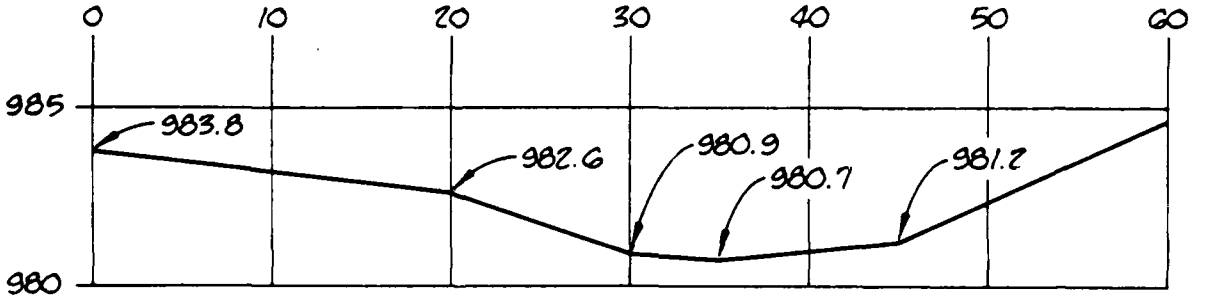
DAM SECTION AT STA. 3+50

Scale: 1" = 10'



℄ PROFILE OF SPILLWAY

Scale: 1" = 20' H.
1" = 10' V.



SPILLWAY SECTION (℄ OF DAM)

Scale: 1" = 10' H.
1" = 5' V.

PLATE C-2

APPENDIX D
HYDRAULIC AND HYDROLOGIC DATA

HYDROLOGIC COMPUTATIONS

1. The SCS dimensionless unit hydrograph and the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Corps of Engineers, Davis, California, were used to develop the inflow hydrographs.

a. Twenty-four hour, 100-year rainfall for the dam location was taken from the data for the rainfall station at Maryville, MO. as supplied by the St. Louis District, Corps of Engineers per their letter dated 6 March 1979. The twenty-four hour probable maximum precipitation was taken from the curves of Hydrometerological Report No. 33 and current Corps of Engineers and St. Louis policy and guidance for hydraulics and hydrology.

b. Drainage area = 0.146 square miles (93.4 acres).

c. Time of concentration of runoff = 14 minutes (computed from "Kirpich" formula).

d. The antecedent storm conditions for the probable maximum precipitation were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The antecedent storm conditions for the 100-year precipitation were an average of the conditions which have preceded the occurrence of the maximum annual flood on numerous watersheds (SCS AMC II). The initial pool elevation was assumed at the spillway crest.

e. The total twenty-four hour storm duration losses for the 100-year storm were 2.75 inches. The total losses for the PMF storm were 1.44 inches. These data are based on SCS runoff curve No. 89 and No. 76 for antecedent moisture conditions, SCS AMC III and AMC II respectively. The watershed is composed of primarily SCS soil group B and consists mostly of cropland planted partially on the contour.

f. Average soil loss rates = 0.05 inch per hour approximately.

2. The discharge rating for the spillway was developed using the Corps of Engineers Surface Water Profile HEC-2 computer program and dimension measured in the field.

The flows over the dam crest were based on the broad-crested weir equation $Q = CLH^{3/2}$, where H is the head on the dam crest; the coefficient C, which varies with head, was taken from the USGS publication "TWRI, Book 3, Chapter 5, Measurement of Peak Discharge at Dams by Indirect Methods" (C values varied from 2.52 to 2.96).

3. Floods were routed through the reservoir using the HEC-1 (Dam Safety Version) program to determine the capacilities of the spillway and dam embankment crest. The input and output data sheets for the one-half PMF are included in this appendix.

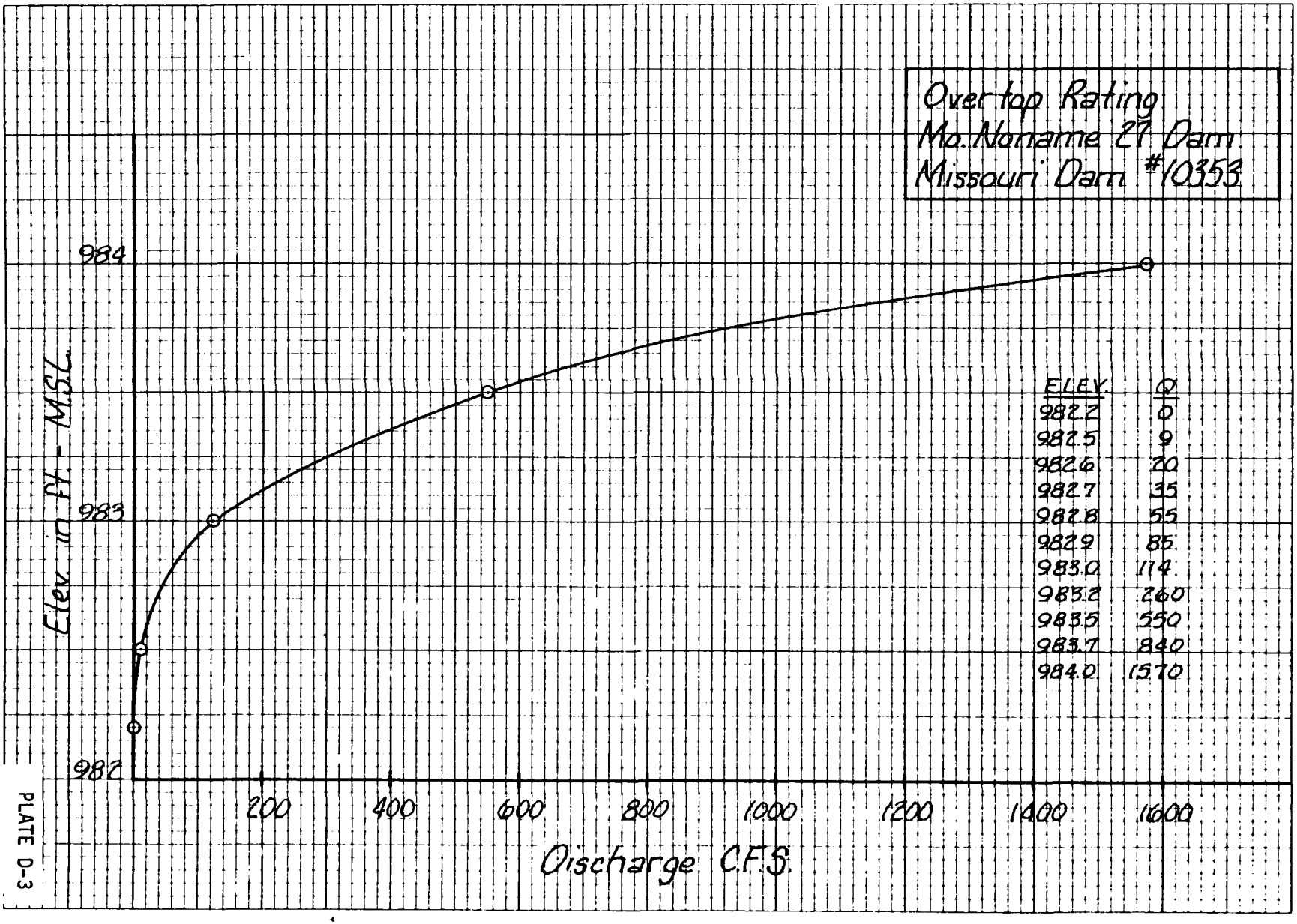


PLATE D-3

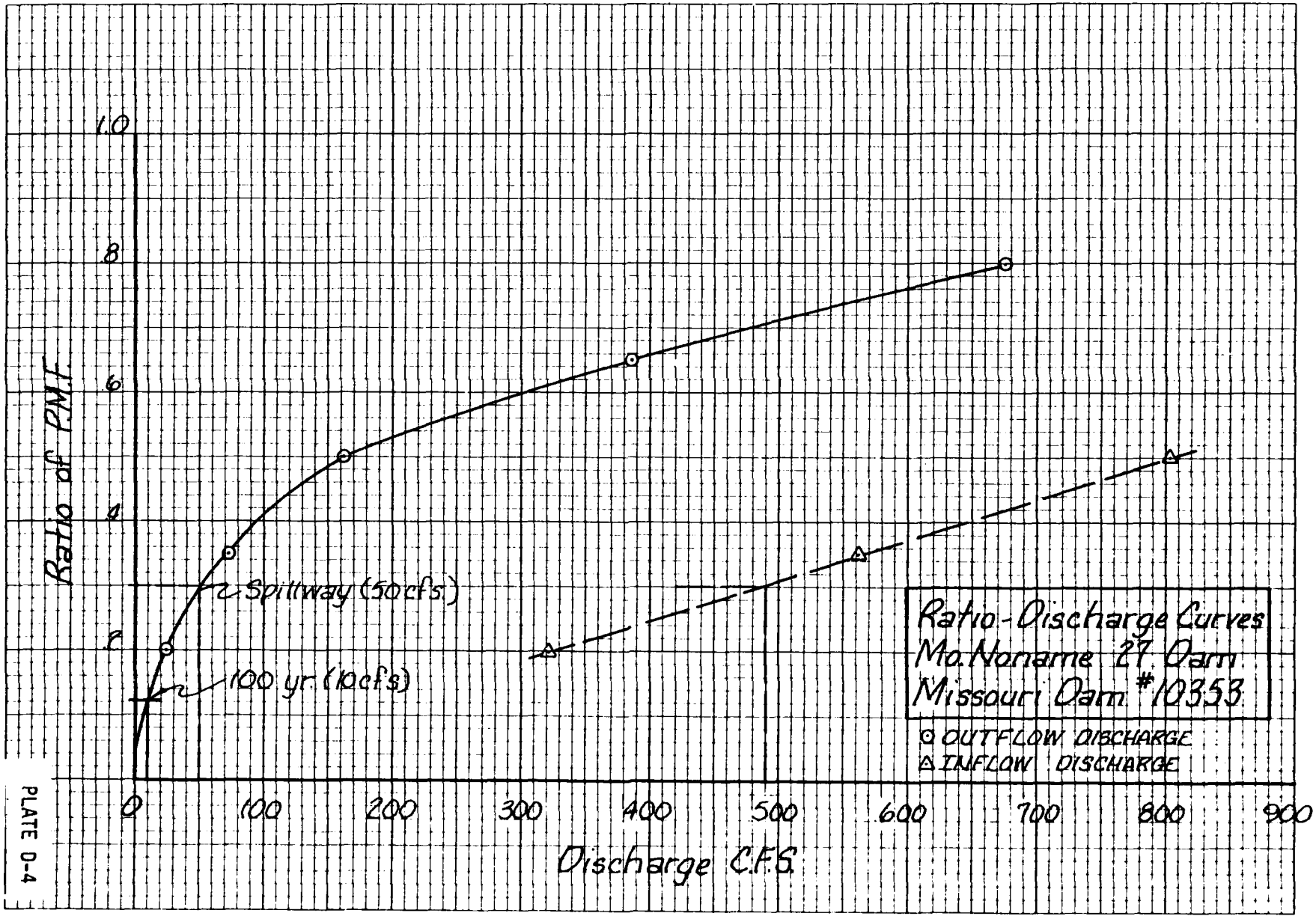


PLATE D-4

```
A1       ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF NO NAME 27-10353
A3       RATIOS OF PMF ROUTED THROUGH THE RESERVOIR
B 000288000000000000005                                  000000000000000000000003
B1000005
J 000001000000030000000001
J1000.2000300.3500000.5000000.6500000.80000001.0
K 000000300000301                                        00000001
K1       CALCULATION OF INFLOW HYDROGRAPH TO 10353 RES.
M 000001000000020000.146        0000.146        1                00000001
P        000023.8000001020000012100000130
T                                                -1.0        -89.
W2       0000.170
X        -.01    00000001
K 00000100000302                          2      00000001
K1       ROUTED FLOWS THRU 10353 RES.
Y                        0000000100000001
Y1000001                                         -980.7        -1
Y40980.7000981.0000981.5000982.2000982.5000982.6000982.7000982.8000982.9000983.0
Y40983.2000983.5000983.7000984.0
Y500000000000302000000100000005000000081000001000000012500000155000001950000240
Y500004150000077000001105000013 10
$500000000000001.0000000150000004000000075000001250000300
$E00095500000960000096500000970000097500000980000000985
$$ 980.7
$00982.2000003.0000001.500000000
K 005029
A
A
A
A
A
```

PLATE D-5

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

RUN DATE= 79/06/20.
TIME= 18.33.57.

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF NO NAME 27-10353
RATIOS OF PMF ROUTED THROUGH THE RESERVOIR

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	0	0	0	0	0	3	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 6 LRTIO= 1

RTIOS= .20 .35 .50 .65 .80 1.00

****

SUB-AREA RUNOFF COMPUTATION

CALCULATION OF INFLOW HYDROGRAPH TO 10353 RES.

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
G00001	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.15	0.00	.15	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.80	102.00	121.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-89.00	0.00	0.00

CURVE NO = -89.00 WETNESS = -1.00 EFFECT CN = 89.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .17

RECESSION DATA
STRTQ= 0.00 QRCSN= -.01 RTIOR= 1.00

UNIT HYDROGRAPH 12 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .17 VOL= 1.00

101.	307.	315.	198.	99.	53.	28.	15.	8.	4.
2.	1.								

END-OF-PERIOD FLOW

PLATE D-6

STAGE	980.70	981.00	981.50	982.20	982.50	982.60	982.70	982.80	982.90	983.00
	983.20	983.50	983.70	984.00						
FLOW	0.00	2.00	10.00	50.00	81.00	100.00	125.00	155.00	195.00	240.00
	415.00	770.00	1105.00	1910.00						

CAPACITY=	0.	1.	15.	40.	75.	125.	300.
ELEVATION=	955.	960.	965.	970.	975.	980.	985.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
980.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
982.2	3.0	1.5	0.

STATION 000002, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	3.	3.	3.	3.	3.	3.
4.	4.	4.	4.	4.	5.	5.	5.	5.	5.
6.	6.	6.	6.	6.	7.	7.	8.	9.	10.
12.	14.	16.	17.	17.	18.	19.	19.	20.	20.
21.	21.	22.	22.	23.	23.	23.	24.	24.	24.
25.	25.	25.	25.	26.	26.	26.	26.	26.	26.
26.	26.	26.	25.	25.	25.	25.	25.	24.	24.
24.	24.	23.	23.	23.	23.	23.	22.	22.	22.
22.	22.	21.	21.	21.	21.	21.	20.	20.	20.
20.	20.	20.	19.	19.	19.	19.	19.	19.	18.
18.	18.	18.	18.	18.	17.	17.	17.	17.	17.
17.	17.	16.	16.	16.	16.	16.	16.	16.	15.
15.	15.	15.	15.	15.	15.	15.	14.		

STORAGE

150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	803.	187.	58.	58.	16643.
CMS	23.	5.	2.	2.	471.
INCHES		11.93	14.73	14.73	14.73
MM		303.10	374.08	374.08	374.08
AC-FT		93.	115.	115.	115.
THOUS CU M		115.	141.	141.	141.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 4

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1044.	243.	75.	75.	21635.
CMS	30.	7.	2.	2.	613.
INCHES		15.51	19.15	19.15	19.15
MM		394.02	486.30	486.30	486.30
AC-FT		121.	149.	149.	149.
THOUS CU M		149.	184.	184.	184.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 5

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1285.	300.	92.	92.	26628.
CMS	36.	8.	3.	3.	754.
INCHES		19.09	23.56	23.56	23.56
MM		484.95	598.52	598.52	598.52
AC-FT		149.	183.	183.	183.
THOUS CU M		183.	226.	226.	226.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 6

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1606.	375.	116.	116.	33285.
CMS	45.	11.	3.	3.	943.
INCHES		23.87	29.45	29.45	29.45
MM		606.19	748.15	748.15	748.15
AC-FT		186.	229.	229.	229.
THOUS CU M		229.	283.	283.	283.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTED FLOWS THRU 10353 RES.

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
000002	1	0	0	2	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-981.	-1

PLATE D-8

DVN

STATION 000002, PLAN 1, RATIO 3

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	3.
3.	3.	3.	3.	3.	3.	3.	3.	3.	4.
4.	4.	4.	4.	4.	4.	4.	5.	5.	5.
6.	6.	6.	7.	7.	7.	8.	8.	8.	9.
9.	9.	10.	11.	12.	13.	15.	16.	18.	19.
20.	22.	24.	25.	27.	28.	30.	32.	33.	35.
36.	37.	39.	40.	42.	45.	50.	62.	77.	97.
119.	135.	147.	153.	158.	160.	162.	162.	162.	162.
162.	162.	162.	162.	161.	161.	159.	157.	155.	154.
152.	151.	149.	148.	147.	145.	144.	141.	137.	132.
126.	121.	115.	111.	106.	101.	98.	94.	91.	88.
85.	83.	80.	79.	78.	76.	75.	74.	72.	71.
70.	69.	68.	66.	65.	64.	63.	62.	61.	60.
59.	58.	57.	56.	55.	54.	53.	52.	52.	51.
50.	50.	49.	49.	48.	48.	47.	47.	47.	46.
46.	45.	45.	45.	44.	44.	43.	43.	43.	42.
42.	42.	41.	41.	41.	40.	40.	40.		

STORAGE

150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
150.	150.	150.	150.	150.	150.	150.	150.	150.	150.
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184.	185.	186.	187.	188.	189.	190.	191.	192.	193.
193.	194.	195.	196.	197.	199.	202.	206.	211.	215.
219.	221.	222.	223.	223.	223.	224.	224.	224.	224.
224.	224.	224.	224.	224.	223.	223.	223.	223.	223.
223.	222.	222.	222.	222.	222.	222.	221.	221.	220.
220.	219.	218.	217.	217.	216.	216.	215.	214.	214.
213.	213.	212.	212.	211.	211.	210.	210.	210.	209.

209.	208.	208.	208.	207.	207.	206.	206.	206.	205.
205.	205.	204.	204.	204.	203.	203.	203.	203.	202.
202.	202.	201.	201.	201.	201.	200.	200.	200.	200.
199.	199.	199.	199.	198.	198.	198.	198.	198.	197.
197.	197.	197.	196.	196.	196.	196.	196.		

STAGE

980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7
980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7
980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7
980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7
980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7
980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7
980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7
980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7	980.7
980.7	980.8	980.8	980.8	980.8	980.8	980.8	980.8	980.8	980.8
980.8	980.8	980.8	980.8	980.8	980.8	980.8	980.8	980.8	980.9
980.9	980.9	980.9	980.9	980.9	980.9	980.9	980.9	980.9	980.9
980.9	980.9	980.9	980.9	980.9	980.9	981.0	981.0	981.0	981.0
981.0	981.0	981.0	981.0	981.0	981.0	981.0	981.0	981.0	981.0
981.0	981.0	981.1	981.1	981.1	981.1	981.1	981.1	981.1	981.1
981.1	981.1	981.1	981.1	981.1	981.1	981.1	981.2	981.2	981.2
981.2	981.2	981.3	981.3	981.3	981.3	981.3	981.4	981.4	981.4
981.4	981.5	981.5	981.5	981.5	981.6	981.6	981.6	981.6	981.7
981.7	981.7	981.7	981.8	981.8	981.8	981.8	981.9	981.9	981.9
982.0	982.0	982.0	982.0	982.1	982.1	982.2	982.3	982.5	982.6
982.7	982.7	982.8	982.8	982.8	982.8	982.8	982.8	982.8	982.8
982.8	982.8	982.8	982.8	982.8	982.8	982.8	982.8	982.8	982.8
982.8	982.8	982.8	982.8	982.8	982.9	982.8	982.8	982.7	982.7
982.7	982.7	982.7	982.6	982.6	982.6	982.6	982.6	982.6	982.5
982.5	982.5	982.5	982.5	982.5	982.5	982.4	982.4	982.4	982.4
982.4	982.4	982.4	982.4	982.3	982.3	982.3	982.3	982.3	982.3
982.3	982.3	982.3	982.3	982.2	982.2	982.2	982.2	982.2	982.2
982.2	982.2	982.2	982.2	982.2	982.2	982.2	982.1	982.1	982.1
982.1	982.1	982.1	982.1	982.1	982.1	982.1	982.1	982.1	982.1
982.1	982.1	982.0	982.0	982.0	982.0	982.0	982.0		

PEAK OUTFLOW IS 162. AT TIME 16.58 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	162.	108.	35.	35.	9953.
CMS	5.	3.	1.	1.	282.
INCHES		6.87	8.81	8.81	8.81
MM		174.56	223.72	223.72	223.72
AC-FT		53.	69.	69.	69.
THOUS CU M		66.	85.	85.	85.

UVF

STATION00002

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

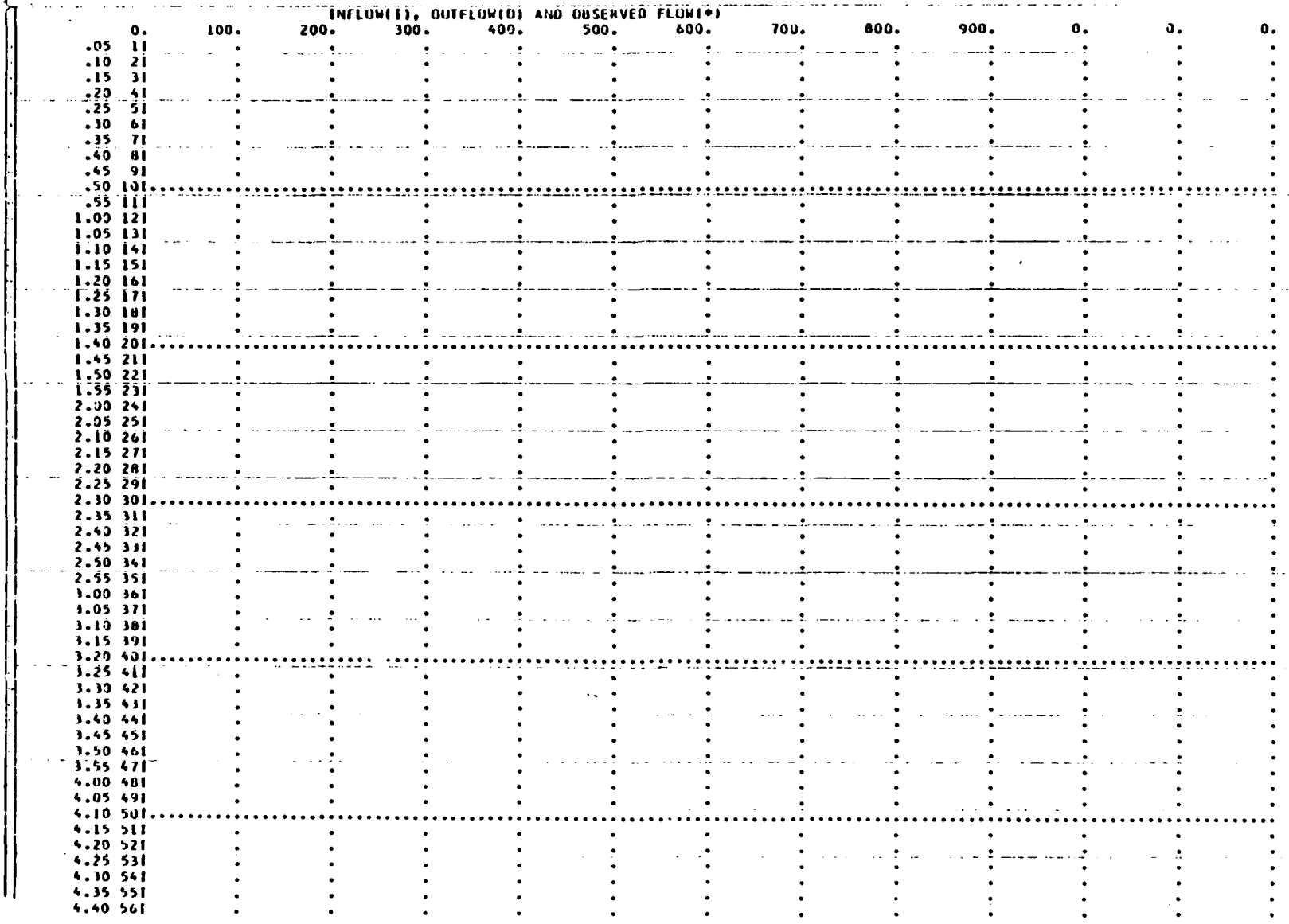

PLATE D-11

4.45 571
4.50 581
4.55 591
5.00 601
5.05 611
5.10 621
5.15 631
5.20 641
5.25 651
5.30 661
5.35 671
5.40 681
5.45 691
5.50 701
5.55 711
6.00 721
6.05 7301
6.10 7401
6.15 7501
6.20 760
6.25 770
6.30 780
6.35 790
6.40 800
6.45 810
6.50 820
6.55 830
7.00 840
7.05 850
7.10 860
7.15 870
7.20 880
7.25 890
7.30 900
7.35 910
7.40 920
7.45 930
7.50 940
7.55 950
8.00 960
8.05 970
8.10 980
8.15 990
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9.501180

PLATE D-12

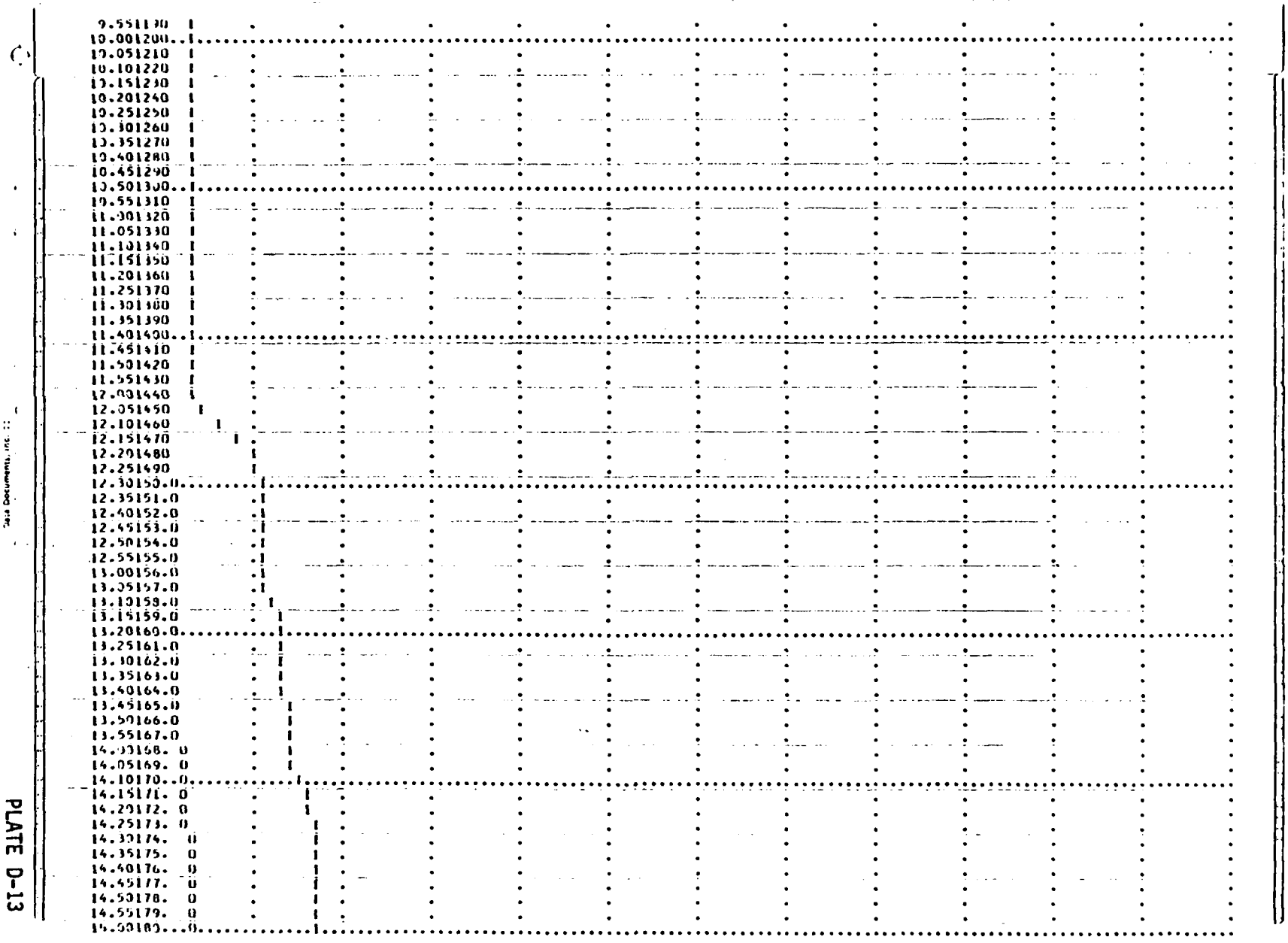
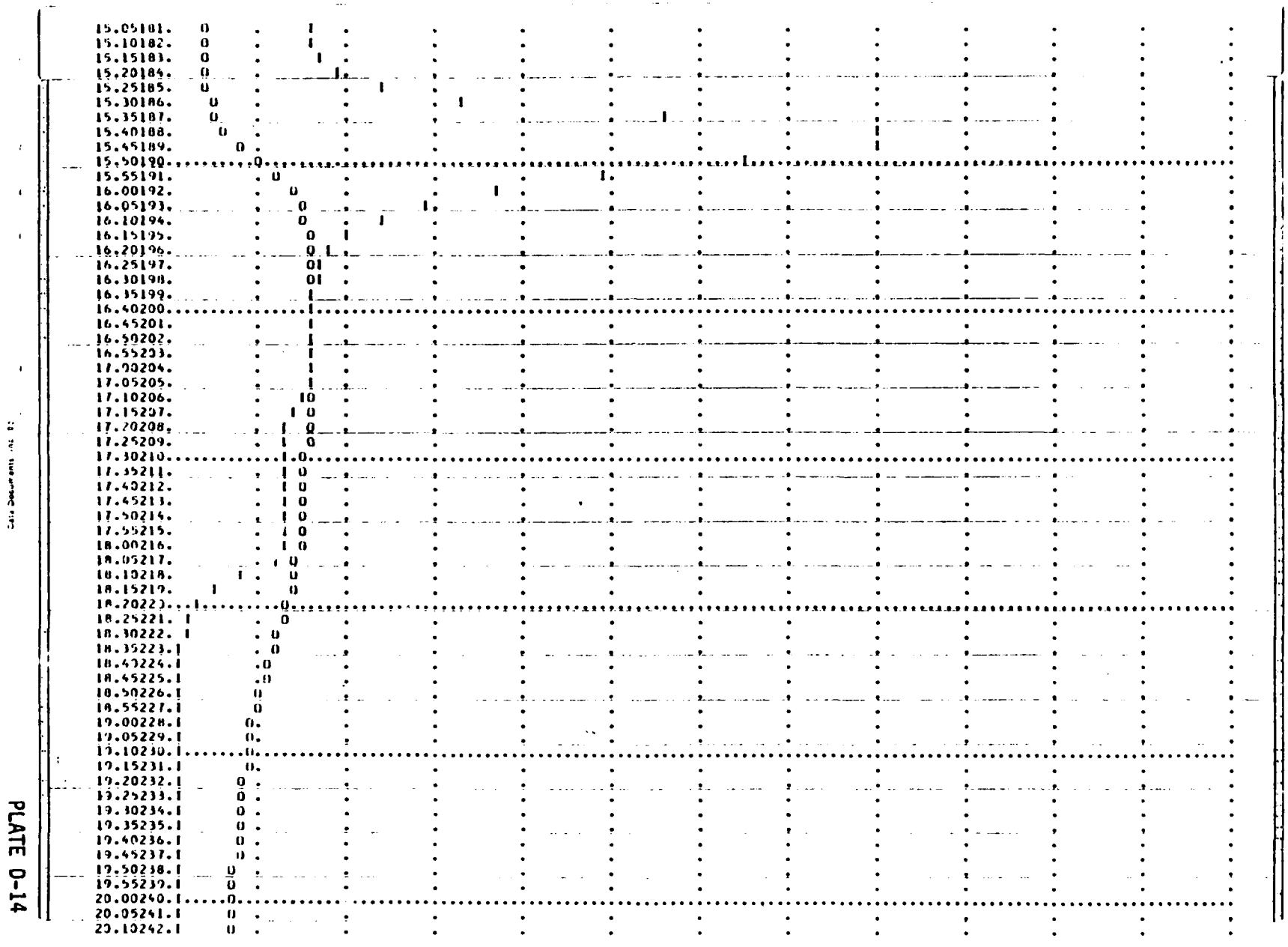


PLATE D-13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15.25185.
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15.35187.
15.40188.
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15.50190.
15.55191.
16.00192.
16.05193.
16.10194.
16.15195.
16.20196.
16.25197.
16.30198.
16.35199.
16.40200.
16.45201.
16.50202.
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17.15207.
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17.30210.
17.35211.
17.40212.
17.45213.
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17.55215.
18.00216.
18.05217.
18.10218.
18.15219.
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18.30222.
18.35223.
18.40224.
18.45225.
18.50226.
18.55227.
19.00228.
19.05229.
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19.20232.
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19.30234.
19.35235.
19.40236.
19.45237.
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19.55239.
20.00240.
20.05241.
20.10242.

PLATE D-14

PLATE D-15

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .20	RATIO 2 .35	RATIO 3 .50	RATIO 4 .65	RATIO 5 .80	RATIO 6 1.00
HYDROGRAPH AT	000001	.15	1	321.	562.	803.	1044.	1285.	1606.
	(	.38)	(	9.10)(	15.92)(	22.74)(	29.56)(	36.39)(	45.48)(
ROUTED TO	000002	.15	1	26.	73.	162.	388.	674.	1035.
	(	.38)	(	.75)(	2.06)(	4.59)(	11.00)(	19.07)(	29.30)(

PLATE D-16

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	980.70	980.70	982.20
STORAGE	150.	150.	202.
OUTFLOW	0.	0.	50.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	981.73	0.00	188.	26.	0.00	18.25	0.00
.35	982.42	.22	210.	73.	4.00	18.08	0.00
.50	982.82	.62	224.	162.	6.08	16.58	0.00
.65	983.17	.97	236.	308.	7.42	16.08	0.00
.80	983.42	1.22	245.	674.	8.50	16.00	0.00
1.00	983.66	1.46	253.	1035.	9.58	15.92	0.00

PLATE D-17


ATE
LME